

# FOREST INSECT AND DISEASE CONDITIONS

in the Intermountain Region

1999



*Compiled by:*

*A. Knapp*

*P. Mocettini*

*D. Halsey*

Forest Health Protection  
State and Private Forestry  
USDA Forest Service  
Intermountain Region



### **Cover story:**

An area infested by leafy spurge, a serious non-native, invasive weed pest, on the Sawtooth National Forest in southern Idaho. This area has been targeted for the release of biological control agents to mitigate its effects on native vegetation. See “Special Project \_Update” for more information.

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**Forest Health Protection  
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USDA Forest Service  
Intermountain Region  
324 - 25th Street  
Ogden, Utah 84401**

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**FOREST HEALTH PROTECTION  
INTERMOUNTAIN REGION**

**Regional Office  
324 - 25th Street  
Ogden, Utah 84401  
(801) 625-5257  
FAX (801) 625-5127**

William W. Boettcher

Director, State and Private,  
Forestry

Dave Baumgartner

Pesticide Coordinator

**Boise Field Office  
1249 South Vinnell Way, Suite 200  
Boise, Idaho 83709  
(208) 373-4220  
FAX (208) 373-4111**

Dayle D. Bennett  
James T. Hoffman  
Ralph W. Thier  
Robert Progar  
Joy C. Roberts  
K. Andrew Knapp  
Philip J. Mocettini, Jr.  
Richard L. Halsey  
Thomas N. Barbouletos

Field Representative  
Pathologist  
Entomologist  
Entomologist  
Computer Specialist  
Remote Sensing Specialist  
Biological Technician  
GIS Specialist  
Forester (Flathead  
National Forest)

**Ogden Field Office  
4746 South 1900 East  
Ogden, Utah 84403  
(801) 476-9720  
FAX (801) 479-1477**

Leon LaMadeleine  
  
Elizabeth Hebertson  
  
A. Steven Munson  
John C. Guyon  
Valerie L. DeBlander  
Alan D. Dymerski  
Laura Dunning

Plant Pathologist/  
Field Representative  
Entomologist/Plant  
Pathologist  
Supervisory Entomologist  
Plant Pathologist  
Forestry Technician  
Forestry Technician  
Program Assistant

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\*\*If the appendices are not included in this document, they can be obtained under separate cover from the Internet at

<http://www.fs.fed.us/r4/health/cr99/cond99.pdf>

or from the Boise Field Office at the address on page iv.

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## **INTRODUCTION**

This report summarizes the status of forest insect and disease activity in the Intermountain Region (Region 4), comprising parts of Idaho, Utah, Nevada, Wyoming and California. Insect status is based largely on aerial detection surveys conducted over approximately 22,600,000 acres of forested lands in 1999. Disease status is based largely on ground observations and surveys. General insect and disease information is summarized in the Summary of Conditions.

The Special Project Update summarizes on-going studies conducted by Forest Health Protection in cooperation with other Regions, Forest Service Research, and universities.

Recent publications are listed to assist the reader in locating recent pest information of interest.

Two appendices include various tables and figures. Acres surveyed by administrative area during 1999 are summarized in Table 1. Numbers of trees killed by major bark beetles and affected acres are displayed in Tables 2 through 9. Figure 1 depicts the relative number of trees killed by bark beetles in Region 4 between 1981 and 1999. Figure 2 depicts acres defoliated by Douglas-fir tussock moth and western spruce budworm in Region 4 between 1960 and 1999. Figure 3 displays the areas aerially surveyed in the Region during 1999. General location of major insect activity is shown in Figures 4 through 7.

If the appendices are not included in this document, they can be obtained under separate cover from the Internet at [www.fs.fed.us/r4/health/cond99fm.htm](http://www.fs.fed.us/r4/health/cond99fm.htm) or from the Boise Field Office at the address on page iv.

## **Summary of Conditions**

Numbers of trees killed and acres defoliated in this summary include adjacent and intermixed state and private lands. For specific information on trees killed and acres defoliated for individual National Forests please refer to Table 9.

Pine mortality attributed to mountain pine beetle increased throughout the Region with 33,900 dying trees observed in 1999 compared to 11,000 trees in 1998. The largest outbreaks in the Region were located on the Salmon-Challis, Sawtooth, and Payette National Forests in southern Idaho, on the Dixie National Forest in southern Utah, and on the Bridger-Teton National Forest in western Wyoming. Elsewhere in the Region smaller mountain pine beetle outbreaks were located on other all National Forests.

Mortality of whitebark and limber pine attributed to mountain pine beetle attack increased significantly with 12,900 trees killed in 1999 compared to 3,200 trees in 1998. Mortality was located throughout host type. Greatest mortality was observed on the Austin and Tonapah Ranger Districts of the Humboldt-Toiyabe National Forest, in Nevada with over 4,000 trees killed.

Scattered ponderosa pine mortality caused by the roundheaded pine beetle was observed on the Dixie and Manti-LaSal National Forests in southern Utah. This mortality was sometimes intermixed with mountain pine beetle activity.

Jeffrey pine beetle caused tree mortality again declined significantly on the Toiyabe National Forest and adjacent Federal, State and private lands in Tahoe Basin with only 300 dead trees recorded.

Spruce beetle mortality decreased from 1998 levels with 71,300 dead trees observed in 1999 compared to 105,500 in 1998. The largest infestations were located in Utah on the Dixie and Manti-LaSal National Forests where 32,500 and 29,300 trees were killed respectively. Mortality was also observed on the Fishlake, Uinta, and Wasatch-Cache National Forests. No significant mortality was observed in southern Idaho or western Wyoming.

Douglas-fir beetle mortality increased Regionwide. In 1999, 68,400 trees were killed compared to 31,300 trees in 1998. In southern Idaho the largest outbreaks were located on the Boise and Payette National Forests. Elsewhere activity was observed on the Caribou, Sawtooth, Salmon-Challis, and Targhee National Forests. In Utah the largest outbreaks were located on the Ashley and Uinta National Forests with other smaller outbreaks located on the Dixie, Fishlake, and Wasatch-Cache National Forests. Mortality on the Bridger-Teton National Forest in western Wyoming increased with 6,800 trees killed compared to 3,600 trees in 1998.

Only small isolated infestations of western pine beetle and pine engraver beetle were recorded in 1999. Most western pine beetle activity was located in southern Idaho while in Utah populations of pine engraver beetle were found in slash of ponderosa and lodgepole pine.

A significant increase in subalpine fir mortality attributed to a complex of insect and disease factors was observed in 1999 with 65,200 trees killed compared to 13,200 trees in 1998. Most of the subalpine fir mortality was located on the Fishlake and Dixie National Forests in southern Utah and the Bridger-Teton National Forest in western Wyoming.

Tree mortality caused by the fir engraver beetle increased significantly in 1999 with 26,600 trees killed compared to 2,600 trees killed in 1998. The largest area of beetle activity was observed on the Humboldt-Toiyabe National Forest.

Smaller outbreaks were located on the Dixie, Manti-LaSal, and Fishlake National Forests in southern Utah. No significant mortality was observed in southern Idaho or western Wyoming.

Approximately 17,000 acres of defoliation from the Douglas-fir tussock moth were observed on state, federal, and private lands in the Owyhee Mountains in southwest Idaho. Pheromone bait trap catches indicated increasing populations in the Weiser and Council Ranger Districts on the Payette National Forest in Idaho. In central Utah, 100 acres of defoliation were observed on the Fishlake National Forest.

Defoliation by the western spruce budworm decreased on the Dixie National Forest in southern Utah from 19,500 acres in 1998 to 900 acres in 1999. In Idaho, approximately 2,500 acres of Douglas-fir were lightly defoliated in the Centennial Mountains on the Targhee National Forest. This is the first aerially observed western spruce budworm defoliation in southern Idaho since 1988.

For the sixth consecutive year gamble oak (*Quercus gambellii*) was defoliated by the fall cankerworm in Utah. Overall acres of defoliation declined from 34,200 in 1998 to 17,700 in 1999. Increases in defoliation occurred in Heber Valley south to Gunnison, Utah while populations decreased along the Wasatch Front in northern Utah.

Along the Wasatch Front in Utah, 764 acres of Federal, state and private lands were treated with *Bacillus thuringiensis* (Bt) for European gypsy moth eradication. This was a cooperative project with the Utah Department of Agriculture. Treatment is one aspect of the integrated pest management approach other components of the eradication program include egg mass surveys, gypsy moth trapping, education, and quarantine.

Foliage diseases were epidemic in *Populus* species throughout the Region. Leaf damage was observed in central and eastern Idaho; northern Utah; and western Wyoming. In southern Idaho incidence of larch needle disease declined.

## **Status of Insects**

### **Insects: Native – Defoliators**

#### **Douglas-fir tussock moth *Orgyia pseudotsugata***

Location: Idaho, Nevada, Utah

Host: Douglas-fir, True firs

Approximately 17,000 acres of defoliation from Douglas-fir tussock moth were observed in the Owyhee Mountains in southwest Idaho and 100 acres of defoliation were observed on the Fishlake National Forest in central Utah. Pheromone bait trap catches indicated increasing populations in the Weiser and Council Ranger Districts on the Payette National Forest.

**Western spruce budworm** *Choristoneura occidentalis*

Location: Idaho, Utah, Wyoming

Host: Douglas-fir, True firs

On the Dixie National Forest in southern Utah defoliation decreased from 19,500 acres in 1998 to 900 acres of light defoliation in 1999. In Idaho, approximately 2,500 acres of mostly light defoliation were mapped on the Targhee National Forest. This is the first western spruce budworm defoliation observed since 1988 in Idaho.

**Insects: Native – Bark beetles**

**Douglas-fir beetle** *Dendroctonus pseudotsugae*

Location: Idaho, Utah, Wyoming

Host: Douglas-fir

Mortality increased with increasing mortality observed in Idaho and Wyoming and static mortality levels in Utah. In 1998, 31,300 trees were killed compared to 68,400 in 1999. Outbreaks were located on the Sawtooth, Boise, Salmon-Challis, Caribou, Targhee and Payette National Forests in southern Idaho. In Utah outbreaks were located on the Manti-LaSal, Ashley, Dixie, Fishlake, Uinta, and Wasatch-Cache National Forests. Mortality on the Bridger-Teton National Forest in western Wyoming increased from 3,600 trees in 1998 to 6,600 trees in 1999.

**Fir engraver beetle** *Scolytus ventralis*

Location: California, Idaho, Nevada, Utah

Host: Grand fir, Red fir, Subalpine fir, White fir

Approximately 26,600 dead trees were observed during aerial surveys in 1999. Virtually all of this mortality occurred on the Humboldt division of the Toiyabe-

Humboldt National Forest in Nevada in areas that had not been aerially surveyed in recent years. Mortality was particularly heavy on the Ely Ranger District. Mortality remained low in Utah with 500 trees killed on the Dixie and Fishlake National Forests. No significant mortality was observed in southern Idaho.

**Jeffrey pine beetle** *Dendroctonus jefferyi*

Location: California, Nevada

Host: Jeffrey pine

Jeffrey pine beetle activity remained static on the Toiyabe National Forest and Tahoe Basin Management area with 300 trees killed in 1999 compared to 400 trees killed in 1998.

**Mountain pine beetle** *Dendroctonus ponderosae*

Location: Idaho, Nevada, Utah, Wyoming, California

Host: Limber, Lodgepole, Jeffrey, Ponderosa, Whitebark pines

Mountain pine beetle-caused mortality increased from 11,000 trees in 1998 to 33,900 trees in 1999. Increasing mortality levels were observed in Idaho and Wyoming while mortality levels in Utah were static. The largest outbreaks in the Region were located on the Sawtooth, Payette, and Salmon-Challis National Forests in southern Idaho in lodgepole pine with a combined total of 13,600 trees killed and on the Dixie National Forest in southern Utah in ponderosa pine with 2,000 trees killed. On the Bridger-Teton National Forest in western Wyoming 1,600 lodgepole pine were killed. Elsewhere in the Region smaller mountain pine beetle outbreaks were located on all national forests except the Toiyabe National Forest.

Mortality of whitebark and limber pine attributed to mountain pine beetle attack increased from 3,200 trees killed in 1998 to 12,900 trees killed in 1999. While mortality was observed throughout the host type greatest mortality was located on the Payette National Forest in southern Idaho with 4,800 trees killed and on the Humboldt and Toiyabe National Forests in Nevada with 1,300 and 500 trees killed, respectively.

**Pine engraver beetle** *Ips pini*

Location: Idaho, Nevada, Utah

Host: Lodgepole, Ponderosa pine

Mortality due to pine engraver beetle remained low throughout the Region. Activity is often associated with western pine beetle. In Utah, populations were found in slash of ponderosa and lodgepole pine.

**Roundheaded pine beetle** *Dendroctonus adjunctus*

Location: Utah

Host: Ponderosa pine

Ponderosa pine mortality attributed to this beetle continues to occur in scattered areas of the Dixie and Manti-LaSal National Forests in southern Utah.

**Spruce beetle** *Dendroctonus rufipennis*

Location: Idaho, Utah, Wyoming

Host: Spruce

Spruce beetle mortality decreased from 1998 levels with 71,300 trees killed in 1999 compared to 105,500 in 1998. The largest infestations were located in Utah where 32,500 trees were killed on the Dixie National Forest and 29,000 trees were killed on the Manti-LaSal National Forest. Mortality was also observed on the Fishlake, Uinta, and Wasatch-Cache National Forests. On the Bridger-Teton National Forest, in western Wyoming, 200 trees were killed. No significant mortality was observed in southern Idaho national forests

**Western pine beetle** *Dendroctonus brevicomis*

Location: Idaho

Host: Ponderosa pine

Only small isolated infestations of western pine beetle were recorded in 1999. Pine engraver beetle activity was frequently associated with western pine beetle infestation.

## **Insects: Native – Others**

**Cooley spruce gall adelgid** *Adelges cooleyi*

Location: Idaho, Utah, Wyoming

Host: Spruce, Douglas-fir

This adelgid was found in forested stands and ornamental trees throughout the Region; impact is greatest on ornamental spruce trees. On Douglas-fir, the alternate host, infested needles often develop a yellow spot and twist at the point of attack.

**Fall cankerworm** *Alsophila pometaria*

Location: Idaho, Utah

Host: Gamble oak

In Utah, approximately 17,700 acres of gamble oak (*Quercus gambellii*) were defoliated in 1999 compared to 34,200 acres in 1998. In 1998 most defoliation occurred along the Wasatch Front in northern Utah while in 1999 most defoliation occurred on the Dixie National Forest in southern Utah. This is the sixth consecutive year of this defoliation.

In southeastern Idaho, approximately 2,000 acres of maple defoliation were reported and attributed to the fall cankerworm. His defoliation reportedly occurred in Oneida County between Preston and Malad.

**Pine Sawflies** *Neodiprion* sp.

Location: Idaho

Host: Ponderosa Pine

Defoliation of lodgepole pine caused by a sawfly was detected on 500 acres of private land near Lakefork, Idaho. Scattered pockets of defoliation were observed on ornamental trees along the Wasatch Front in Utah.

## **Insects: Non-native**

**European gypsy moth** *Lymantria dispar*

Location: Idaho, Nevada, Utah

Host: Various deciduous species

The gypsy moth was first detected in Utah in 1988. Between 1989 and 1993 approximately 72,000 acres of Federal, State, and private lands were treated with *Bacillus thuringiensis* (Bt). In 1995, after two years of intensive trapping resulting in no moth captures, the gypsy moth was declared eradicated. In 1997, 46 moths were captured in Salt Lake City and one moth was captured on the

Wasatch-Cache National Forest. During 1998 the Utah Department of Agriculture, in cooperation with the USDA Forest Service, treated 980 acres.

An additional 764 acres in Salt Lake County were aerially treated in 1999. Three applications were made at 5-7 day intervals. Treatment was 95% effective with only one gypsy moth caught in the treatment area in 1999. Five additional single moth catches occurred in Salt Lake County, but outside the treatment area. In 2000, a ten acre mass trapping grid will be installed around each positive catch using nine pheromone traps per acre. Statewide detection trapping will continue at current levels.

## **Status of Diseases**

### **Diseases: Native - Stem and Branch Diseases**

#### **Dwarf mistletoes *Arceuthobium spp***

Location: Idaho, Nevada, Utah, Wyoming

Host: Douglas-fir, Pines, Western Larch

Suppression projects continue to remove infected overstory trees; however, this forest disease remains the most widespread and frequently observed disease within the Intermountain Region. Regional incidence by major host species is estimated as follows: lodgepole pine 50 percent, ponderosa pine 20 percent, and Douglas-fir 20 percent infected. These numbers represent the percentage of host stands having some level of infection.

#### **True mistletoe on Juniper *Phoradendron juniperinum***

Location: Nevada, Utah

Host: Junipers

Occurring throughout the pinyon-juniper forest type in Utah and Nevada, this disease spreads and intensifies slowly and is therefore more common in older stands.

## **Diseases: Native - Root Diseases**

### **Annosus root disease** *Heterobasidion annosum*

Location: California, Idaho, Nevada, Utah, Wyoming

Host: Bitterbrush, Chokecherry, Douglas-fir, Jeffrey pine, Lodgepole pine, ponderosa pine, Spruce, True firs

This root disease fungus can be found throughout the Region, but mostly as a decay organism. The fungus is occasionally damaging to young, planted stands of ponderosa pine on droughty soils.

### **Armillaria root disease** *Armillaria* spp.

Location: Idaho, Nevada, Utah, Wyoming

Host: Douglas-fir, Grand fir, Pines, Spruce, Subalpine fir

Evidence of Armillaria root disease can be found throughout the Region functioning primarily as a weak pathogen or saprophyte causing little direct mortality. In southern Utah, it may act as a primary pathogen, killing mature and immature ponderosa pine and mature fir and spruce.

### **Black stain root disease** *Ophiostoma wagneri*

Location: Idaho, Nevada, Utah

Host: Pinyon pine

This fungus caused mortality of pinyon pine on the Bureau of Land Management Burley District in Idaho, on the Humboldt and Toiyabe National Forests in Nevada, and on the Dixie and Manti-LaSal National Forests in Utah.

## **Diseases: Non-native**

### **White pine blister rust** *Cronartium ribicola*

Location: Idaho, Wyoming, Nevada

Host: Limber, whitebark, bristlecone, western white, sugar pine

This introduced disease is common throughout its host ranges in southern Idaho and western Wyoming. It is present in the western portion of Nevada. No infection has been reported in Utah.

## **Declines/Complexes**

### **Subalpine fir Mortality Complex**

*Dryocetes confusus*, *Pityophthorus* sp., *Pityokeines* sp., *Crypturgus* sp., *Scolytus* sp., *Heterobasidion annosus*, *Armillaria* sp., *Cytospora abietis*, *Melampsorella caryophyllacearum*

Location: Idaho, Nevada, Utah, Wyoming

Host: Subalpine fir

Subalpine fir decline and mortality continues to occur throughout host type in the Region. Ground examinations suggest a complex of factors are involved in this mortality. These factors include: twig beetles, secondary bark beetles, wood borers, engraver beetles, root diseases, cankers, rusts, and environmental conditions.

A significant increase in mortality was observed in 1999 with 58,000 trees killed compared to 13,200 trees killed in 1998. Mortality was located on all National Forests in Utah. The largest area of mortality in the Region is located on the Bridger-Teton National Forest in western Wyoming where 20,100 trees were killed. In Idaho, 1,100 trees were killed on the Caribou National Forest.

## **SPECIAL PROJECT UPDATE**

### **Fire Survival Plots**

Fire survival plots were installed in 1995 in six areas burned during 1994 wildfires on the Payette National Forest. These areas were selected because they represented underburn conditions in Douglas-fir, grand fir, and subalpine fir habitat types. The objective of this study is to develop criteria which would accurately classify trees expected to die as a result of fire injury. These plots were again monitored in 1999. Contact: Ralph Their.

### **Permanent Plots to Validate Forest Disease Models**

This is an ongoing project to establish permanent plots to aid in the validation of disease models including the dwarf mistletoe model, the western root disease

model, as well as models for comandra blister rust and limb rust. These plots were installed in forests containing ponderosa pine, lodgepole pine, and Douglas-fir dwarf mistletoes. Contact: John Guyon.

### **Thinning Second Growth Ponderosa Pine as a Management Strategy for Western Pine Beetle**

Evaluation of an investigation on the Idaho City Ranger District, Boise National Forest, continues to determine if differences exist in tree mortality among stands of second growth ponderosa pine thinned to two different densities and an unthinned check stand in the presence of western pine beetle infestation. Plots were monitored in 1999 and an establishment report begun. Contact: Ralph Thier

### **Biological Control for Noxious Weed Management**

These projects involve coordination with federal agencies, multi-state agencies, counties, universities, and private individuals in collecting and exchanging biological agents to conduct operational and insectary releases for the management of noxious weeds. Information, new technologies, and educational materials are developed and shared in a collaborative stewardship approach to this growing problem. Contact: Tom Barbouletos

### **Leafy Spurge Special Technology Development Project.**

The field work for this project has been completed. Most of the infestation has been mapped, site characteristics have been delineated, agent populations have been monitored and a study to determine the impact of released agents has been completed. Analysis of the data continues and a report will be completed this spring. Contact: Tom Barbouletos.

### **Integrating Aggressive Biological into a Leafy Spurge Management Project**

The purpose of this project, initiated in 1999, is to improve the effectiveness of a leafy spurge management program and to demonstrate that biological control can be an important tool when included in integrated management programs. Fieldwork and data analysis will continue on this project in 2000. A final report will be completed and issued in 2001. Contact: Dayle Bennett

### **Tools and Information for Predicting and Monitoring Spruce Beetle Populations**

Plots monitoring phloem temperatures of infested Englemann spruce trees and associated insect development were initially installed on the Dixie and Wasatch-Cache National Forests in 1997. A variety of phloem temperature based parameters are being examined for strength of correlation (predictive power) with

life cycle duration. Preliminary results indicate that average temperature for the larval growing season (July-Sept.) has a strong correlation with voltinism. Lab experiments to determine lifestage specific, temperature dependent development and thresholds were completed in 1999. Data from this study, in conjunction with the field data, will be used to develop a phenology model and classification rule for predicting one year versus two-year populations. A final report has been completed and will be submitted to a refereed Journal for publication. Contact: Steve Munson.

### **Factors Influencing Spruce Beetle Population Dynamics and Silvicultural Implications for Spruce Beetle Management**

Study sites were established on the Manti-LaSal National Forest to monitor seasonal availability of downed host material. The objective is to determine whether spruce beetle colonization, brood production, and larval survival differ with respect to the time of year downed host material is produced. Study pairs of Englemann spruce were selected and dropped, one in the fall of 1996 and the other in the spring of 1997 before beetle flight. All trees were visited in late July-August of 1997 to record attacks on each host. In the spring of 1999 trees were sampled to quantify the number of emerging adults. Data analysis is complete and a final report will be prepared for publication in 2000. Contact: Liz Hebertson

### **Mountain Pine Beetle Susceptibility/Risk Rating in Southwestern Ponderosa Pine**

A logistic regression model has been developed that uses stand attributes and a measure of current beetle activity to predict probability of tree mortality within a stand (Chojnacky, in review). Additional analysis of the field data is ongoing, testing the use of regression trees to identify statistically significant parameters for susceptibility or risk, including parameters of host clumpiness. The discriminatory power of a susceptibility or risk model will be increased if all trees within a stand have been challenged by beetles and if the sequence of tree mortality is known. Forty-five permanent plot sites will be monitored on a two to three year interval to record new infested trees. Once the outbreak sequence is observed, the data will be used to validate the existing risk model. This is a collaborative effort among FHP staff in Regions 2, 3, and 4, and RWU 4501 in the Rocky Mountain Research Station. A final report will be completed in 2000. Contact: Steve Munson.

### **Spruce Beetle Suppression Study**

A spruce beetle suppression project was completed on the Logan Ranger District, Wasatch-Cache National Forest to evaluate the use of multiple treatment tactics. Three trap clusters of pheromone traps baited with the component attractant for spruce beetle, trap trees and sanitation treatments were used to suppress a localized population of spruce beetle on the T.W. Daniel Experimental Forest. The Experimental Forest is administered jointly by Utah State University and the Forest Service. A portion of the School Forest used

pheromone traps and trap trees exclusively to suppress beetle populations. A research paper has been submitted and accepted for publication in the Western Journal of Applied Forestry. Participants in the study include RWU 4501 - Rocky Mountain Station and FHP, Ogden Field Office. Contact: Steve Munson.

### **Spruce Beetle Management Strategies**

Permanent plots were installed on the Fishlake National Forest to evaluate density management strategies that may mitigate spruce beetle impacts in stands of Englemann spruce. Plots were established in treated stands that are between 150 -500 acres in size. All treated stands were within a larger contiguous landscape of spruce covering several thousand acres. Treatments occurred on National Forest, State and private lands. Contact: Liz Hebertson

### **Bacillus thuringiensis var. kurstaki Fingerprinting**

In response to the growing concern about the environmental effects of broad spectrum synthetic chemical insecticides, biological control insecticides, such as *Bacillus thuringiensis* var. *Kurstaki* (Btk), a study was designed to develop methods to screen, identify, and differentiate between applied and native biological materials. The objective of this study is to determine if Cellular Fatty Acid (CFA) analysis using gas chromatography can be used to identify and differentiate microbial CFA's and fingerprint various Btk and Bti preparations at the species and subspecies level. Preliminary results from the Center of Bioremediation at Weber State University indicate fingerprinting can be done on commercial preparations and stock Btk samples. A final report will be submitted to Forest Health Protection by Weber State in 2000. Contact: John Anhold.

### **Documenting Biodiversity of Non-Target Arthropods along the Wasatch Front**

The Carnegie Museum of Natural History began this study in 1997 to document the biodiversity of non-target arthropods in sites that may have been affected by *Bacillus thuriengensis* (*B.t.*) applications. The aerial applications were conducted to eradicate populations of gypsy moth on the Wasatch-Cache and Uinta National Forests, Utah. In 1999 sampling was conducted to assess non-target impacts at two application sites. Additional sampling occurred in lower and higher elevation sites to document local fauna adjacent to treated sites. A final report will be completed in 2000. Contact: John Anhold

**Douglas-fir Modeling** In 1997, 1998 and 1999 plots were established in Douglas-fir stands on the Wasatch-Cache and Manti-LaSal National Forests, Utah, to develop a spatial model of Douglas-fir basal area as a predictor of Douglas-fir beetle caused mortality. The study sampled the spatial distribution of Douglas-fir beetle impacted stands. If the spatial distribution of Douglas-fir basal area can be correlated with actual mortality caused by the Douglas-fir beetle then sampling protocols will be developed that could be used to rate stands in their susceptibility to damage by sampling the spatial distribution of Douglas-fir basal

area. Data analysis and manuscript preparation was completed in 1999. A final report has been submitted to Environmental Entomology.  
Contact: Steve Munson.

## RECENT PUBLICATIONS

**Bentz, B.J. and A.S. Munson. 2000.** Spruce beetle population suppression in northern Utah. Western Journal of Applied Forestry (in press).

**Dymerski, A.D., J.A. Anhold, and A.S. Munson. 2000.** Spruce Beetle, *Dendroctonus rufipennnis* outbreak in Englemann spruce, *Picea engelmannii* in central Utah, 1986-1998. Great Basin Naturalist (in press).

**Haverty, M., P. Shea, J. Hoffman, J. Wenz, and K. Gibson. 1998.** Effectiveness of Esfenvalerate, Cyfluthrin, and Carbaryl in Protecting Individual Lodgepole Pines and Ponderosa Pines from Attack by *Dendroctonus* spp. Research Paper PSW-RP-237. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 12p.

**Holsten, E.H., R.W. Thier, A.S. Munson, and K.E. Gibson. 1999.** The spruce beetle. Forest Insect and Disease Leaflet #127. USDA Forest Service, Forest Health Protection. 12 pp.

**Negron, J.F., J.L. Wilson, and J.A. Anhold. 2000.** Stand conditions associated with roundheaded pine beetle (Coleoptera: Scolytidae) infestations in Arizona and Utah. Environmental Entomology 29:20-27.

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## APPENDIX A

TABLE 1 Number of acres aerially surveyed by administrative area during 1999.

| YEAR              | OWNERSHIP                           | ACRES FLOWN       |
|-------------------|-------------------------------------|-------------------|
| 1999              | Boise NF                            | 2,057,682         |
| 1999              | Ashley NF                           | 921,627           |
| 1999              | BLM                                 | 936,200           |
| 1999              | BT-NF                               | 2,400,900         |
| 1999              | Caribou NF                          | 1,009,200         |
| 1999              | Challis NF                          | 632,400           |
| 1999              | Bureau of Reclamation               | 50,500            |
| 1999              | Dixie NF                            | 1,410,300         |
| 1999              | Fishlake NF                         | 1,105,400         |
| 1999              | Fort Hall Indian<br>Reservation     | 60,300            |
| 1999              | Bryce Canyon National<br>Park       | 29,800            |
| 1999              | State and Private Lands,<br>Idaho   | 1,806,900         |
| 1999              | State and Private Lands,<br>Nevada  | 82,500            |
| 1999              | Manti-LaSal NF                      | 1,215,600         |
| 1999              | Cedar Breaks NM                     | 6,000             |
| 1999              | Payette NF                          | 1,495,800         |
| 1999              | Salmon NF                           | 1,187,200         |
| 1999              | Sawtooth NF                         | 1,511,600         |
| 1999              | Targhee NF                          | 953,624           |
| 1999              | Toiyabe NFs                         | 136,634           |
| 1999              | Uinta NF                            | 732,200           |
| 1999              | State and Private Lands,<br>Utah    | 1,738,100         |
| 1999              | Wasatch-Cache NF                    | 940,900           |
| 1999              | State and Private Lands,<br>Wyoming | 192,300           |
| 1999              | Glen Canyon NP                      | 45,000            |
| <b>1999 Total</b> |                                     | <b>22,593,658</b> |

TABLE 2 Status of mountain pine beetle infestations by state during 1999.

| State                | Land Ownership Class | Outbreak Area<br>(Thousand Acres) | Number of Trees<br>(Thousands) |
|----------------------|----------------------|-----------------------------------|--------------------------------|
| Idaho                | National Forest      | 16.3                              | 20.0                           |
|                      | Other Federal        | 0.4                               | 0.5                            |
|                      | State and Private    | 1.0                               | 1.2                            |
| <b>Idaho Total</b>   |                      | <b>17.7</b>                       | <b>21.7</b>                    |
| Nevada               | National Forest      | 1.4                               | 3.4                            |
|                      | Other Federal        | 0                                 | 0                              |
|                      | State and Private    | 0                                 | 0                              |
| <b>Nevada Total</b>  |                      | <b>1.4</b>                        | <b>3.4</b>                     |
| Utah                 | National Forest      | 3.4                               | 6.4                            |
|                      | Other Federal        | 0.1                               | 0.1                            |
|                      | State and Private    | 0.2                               | 0.5                            |
| <b>Utah Total</b>    |                      | <b>3.7</b>                        | <b>7.0</b>                     |
| Wyoming              | National Forest      | 0.9                               | 1.8                            |
|                      | Other Federal        | 0                                 | 0                              |
|                      | State and Private    | 0                                 | 0                              |
| <b>Wyoming Total</b> |                      | <b>0.9</b>                        | <b>1.8</b>                     |
| <b>Grand Total</b>   |                      | <b>23.7</b>                       | <b>33.9</b>                    |

TABLE 3 Status of spruce beetle infestations by state during 1999.

| State                | Land Ownership Class | Outbreak Area<br>(Thousand Acres) | Number of Trees<br>(Thousands) |
|----------------------|----------------------|-----------------------------------|--------------------------------|
| Idaho                | National Forest      | 0.1                               | 0.1                            |
|                      | Other Federal        | 0.0                               | 0.0                            |
|                      | State and Private    | 0.0                               | 0.0                            |
| <b>Idaho Total</b>   |                      | <b>0.1</b>                        | <b>0.1</b>                     |
| Utah                 | National Forest      | 37.5                              | 66.9                           |
|                      | Other Federal        | 1.0                               | 1.2                            |
|                      | State and Private    | 1.8                               | 2.9                            |
| <b>Utah Total</b>    |                      | <b>40.3</b>                       | <b>71.0</b>                    |
| Wyoming              | National Forest      | 0.1                               | 0.2                            |
|                      | Other Federal        | 0                                 | 0                              |
|                      | State and Private    | 0                                 | 0                              |
| <b>Wyoming Total</b> |                      | <b>0.1</b>                        | <b>0.2</b>                     |
| <b>Grand Total</b>   |                      | <b>40.5</b>                       | <b>71.3</b>                    |

TABLE 4 Status of Douglas-fir beetle infestations by state during 1999.

| State                | Land Ownership Class | Outbreak Area<br>(Thousand Acres) | Number of Trees<br>(Thousands) |
|----------------------|----------------------|-----------------------------------|--------------------------------|
| Idaho                | National Forest      | 29.1                              | 41.1                           |
|                      | Other Federal        | 1.2                               | 1.5                            |
|                      | State and Private    | 1.3                               | 1.8                            |
| <b>Idaho Total</b>   |                      | <b>31.6</b>                       | <b>44.4</b>                    |
| Nevada               | National Forest      | 0.1                               | 0.1                            |
|                      | Other Federal        | 0.1                               | 0.3                            |
|                      | State and Private    | 0                                 | 0                              |
| <b>Nevada Total</b>  |                      | <b>0.2</b>                        | <b>0.4</b>                     |
| Utah                 | National Forest      | 5.1                               | 14.6                           |
|                      | Other Federal        | 0.4                               | 0.8                            |
|                      | State and Private    | 0.6                               | 1.4                            |
| <b>Utah Total</b>    |                      | <b>6.1</b>                        | <b>16.8</b>                    |
| Wyoming              | National Forest      | 2.9                               | 6.6                            |
|                      | Other Federal        | 0.1                               | 0.1                            |
|                      | State and Private    | 0.1                               | 0.1                            |
| <b>Wyoming Total</b> |                      | <b>3.1</b>                        | <b>6.8</b>                     |
| <b>Grand Total</b>   |                      | <b>41.0</b>                       | <b>68.4</b>                    |

TABLE 5 Status of western pine beetle/lps beetle infestations by state during 1999.

| State              | Land Ownership Class | Outbreak Area<br>(Thousand Acres) | Number of Trees<br>(Thousands) |
|--------------------|----------------------|-----------------------------------|--------------------------------|
| Idaho              | National Forest      | 0.2                               | 0.1                            |
|                    | Other Federal        | 0.0                               | 0.0                            |
|                    | State and Private    | 0.1                               | 0.1                            |
| <b>Idaho Total</b> |                      | <b>0.3</b>                        | <b>0.2</b>                     |
| <b>Grand Total</b> |                      | <b>0.3</b>                        | <b>0.2</b>                     |

TABLE 6 Status of Jeffrey pine beetle infestations by state during 1999.

| State               | Land Ownership Class | Outbreak Area<br>(Thousand Acres) | Number of Trees<br>(Thousands) |
|---------------------|----------------------|-----------------------------------|--------------------------------|
| Nevada              | National Forest      | 0.0                               | 0.0                            |
|                     | Other Federal        | 0.0                               | 0.0                            |
|                     | State and Private    | 0.1                               | 0.1                            |
| <b>Nevada Total</b> |                      | <b>0.1</b>                        | <b>0.1</b>                     |
| <b>Grand Total</b>  |                      | <b>0.2</b>                        | <b>0.3</b>                     |

TABLE 7 Status of subalpine fir mortality complex by state during 1999.

| State                | Land Ownership Class | Outbreak Area<br>(Thousand Acres) | Number of Trees<br>(Thousands) |
|----------------------|----------------------|-----------------------------------|--------------------------------|
| Idaho                | National Forest      | 1.3                               | 1.5                            |
|                      | Other Federal        | 0.6                               | 0.9                            |
|                      | State and Private    | 3.8                               | 2.5                            |
| <b>Idaho Total</b>   |                      | <b>5.7</b>                        | <b>4.9</b>                     |
| Utah                 | National Forest      | 10.2                              | 35.2                           |
|                      | Other Federal        | 0.1                               | 0.6                            |
|                      | State and Private    | 1.1                               | 3.5                            |
| <b>Utah Total</b>    |                      | <b>11.4</b>                       | <b>39.3</b>                    |
| Wyoming              | National Forest`     | 6.0                               | 20.1                           |
|                      | Other Federal        | 0.2                               | 0.7                            |
|                      | State and Private    | 0.1                               | 0.2                            |
| <b>Wyoming Total</b> |                      | <b>6.3</b>                        | <b>21.0</b>                    |
| <b>Grand Total</b>   |                      | <b>23.4</b>                       | <b>65.2</b>                    |

TABLE 8 Status of fir engraver beetle infestations by state during 1999.

| State               | Land Ownership Class | Outbreak Area<br>(Thousand Acres) | Number of Trees<br>(Thousands) |
|---------------------|----------------------|-----------------------------------|--------------------------------|
| Utah                | National Forest      | 0.7                               | 1.9                            |
|                     | Other Federal        | 0.0                               | 0.0                            |
|                     | State and Private    | 0.2                               | 0.4                            |
| <b>Utah Total</b>   |                      | <b>0.9</b>                        | <b>2.3</b>                     |
| Nevada              | National Forest      | 8.2                               | 23.8                           |
|                     | Other Federal        | 0.2                               | 0.4                            |
|                     | State and Private    | 0.1                               | 0.1                            |
| <b>Nevada Total</b> |                      | <b>8.5</b>                        | <b>24.3</b>                    |
| <b>Grand Total</b>  |                      | <b>9.4</b>                        | <b>26.6</b>                    |

TABLE 9. Number of trees killed and acres affected by bark beetles on National Forests of Region 4 during 1999 as determined by aerial detection surveys. Trees and acres in thousands.

| Forest        | Mountain Pine Beetle |       | Douglas-fir Beetle |       | Western Pine Beetle/lps |       | Spruce Beetle |       | Fir Engraver Beetle |       | Subalpine Fir Mortality Complex |       | Jeffrey Pine Beetle |       | Totals |        |
|---------------|----------------------|-------|--------------------|-------|-------------------------|-------|---------------|-------|---------------------|-------|---------------------------------|-------|---------------------|-------|--------|--------|
|               | Trees                | Acres | Trees              | Acres | Trees                   | Acres | Trees         | Acres | Trees               | Acres | Trees                           | Acres | Trees               | Acres | Trees  | Acres  |
| Ashley        | 1.3                  | 1.3   | 4.7                | 1.45  | 0                       | 0     | .1            | .050  | 0                   | 0     | 2.4                             | .5    | 0                   | 0     | 8.5    | 3.3    |
| Boise         | .8                   | .7    | 9.1                | 5.7   | .1                      | .2    | 0             | 0     | 0                   | 0     | 0                               | 0     | 0                   | 0     | 10.0   | 6.6    |
| Bridger-Teton | 1.6                  | .8    | 5.9                | 2.6   | 0                       | 0     | .2            | .1    | 0                   | 0     | 20.1                            | 6.0   | 0                   | 0     | 27.8   | 9.5    |
| Caribou       | .1                   | .1    | 2.3                | 1.4   | 0                       | 0     | 0             | 0     | 0                   | 0     | 1.1                             | 1.0   | 0                   | 0     | 3.5    | 2.5    |
| Challis       | 7.0                  | 5.1   | .05                | .4    | 0                       | 0     | 0             | 0     | 0                   | 0     | 0                               | 0     | 0                   | 0     | 7.05   | 5.5    |
| Dixie         | 2.0                  | .9    | 1.1                | .4    | 0                       | 0     | 32.5          | 18.2  | .7                  | .3    | 7.0                             | 2.1   | 0                   | 0     | 43.0   | 21.9   |
| Fishlake      | 1.5                  | .5    | 1.8                | .6    | 0                       | 0     | 4.6           | 2.1   | .8                  | .3    | 16.8                            | 5.2   | 0                   | 0     | 25.5   | 8.7    |
| Manti-LaSal   | .8                   | .4    | 1.5                | .6    | 0                       | 0     | 29.3          | 16.7  | .2                  | .1    | 3.6                             | .7    | 0                   | 0     | 35.4   | 18.5   |
| Payette       | 5.3                  | 5.7   | 16.1               | 12.5  | 0                       | 0     | .1            | 50    | 0                   | 0     | 0                               | 0     | 0                   | 0     | 21.5   | 18.25  |
| Salmon        | .2                   | .1    | .95                | .6    | 0                       | 0     | 0             | 0     | 0                   | 0     | 0                               | 0     | 0                   | 0     | 1.15   | .7     |
| Sawtooth      | 6.3                  | 4.2   | 1.6                | .9    | 0                       | 0     | 0             | 0     | 0                   | 0     | 0                               | .4    | 0                   | 0     | 7.9    | 5.5    |
| Targhee       | .3                   | .15   | .8                 | .3    | 0                       | 0     | 0             | 0     | 0                   | 0     | 0                               | 0     | 0                   | 0     | 1.1    | .45    |
| Toiyabe       | 4.0                  | 1.6   | .1                 | .05   | 0                       | 0     | 0             | 0     | 24.0                | 8.3   | 1.4                             | .3    | .3                  | .2    | 29.8   | 10.45  |
| Uinta         | 0                    | 0     | 3.1                | 1.1   | 0                       | 0     | .3            | .2    | .2                  | .1    | 2.9                             | .8    | 0                   | 0     | 6.5    | 2.2    |
| Wasatch-Cache | .9                   | .5    | 2.2                | .6    | 0                       | 0     | .4            | .3    | 0                   | 0     | 2.7                             | 1.0   | 0                   | 0     | 6.2    | 2.4    |
| <b>TOTAL</b>  | 32.1                 | 22.05 | 51.3               | 29.2  | .1                      | .2    | 67.5          | 37.7  | 25.9                | 9.1   | 58.0                            | 18.0  | .3                  | .2    | 235.2  | 116.45 |

**Figure 1**

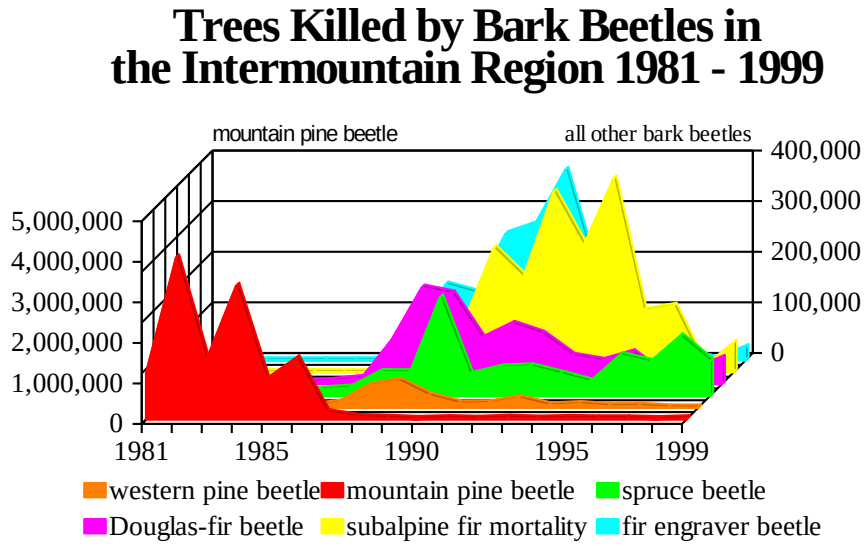


**Figure 2**

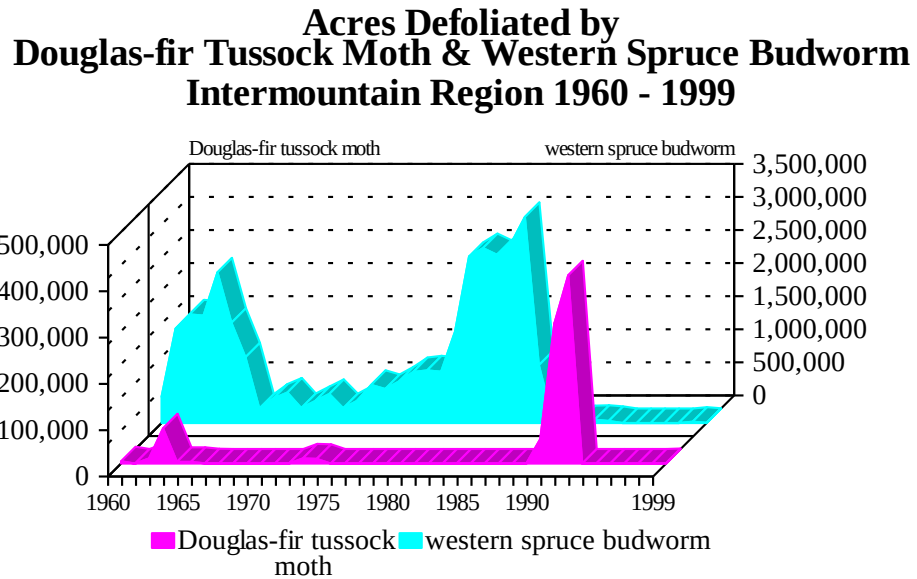


Figure 3. *Tree mortality associated with mountain pine beetle and Jeffrey pine beetle in Region 4 - 1999 aerial detection survey.*

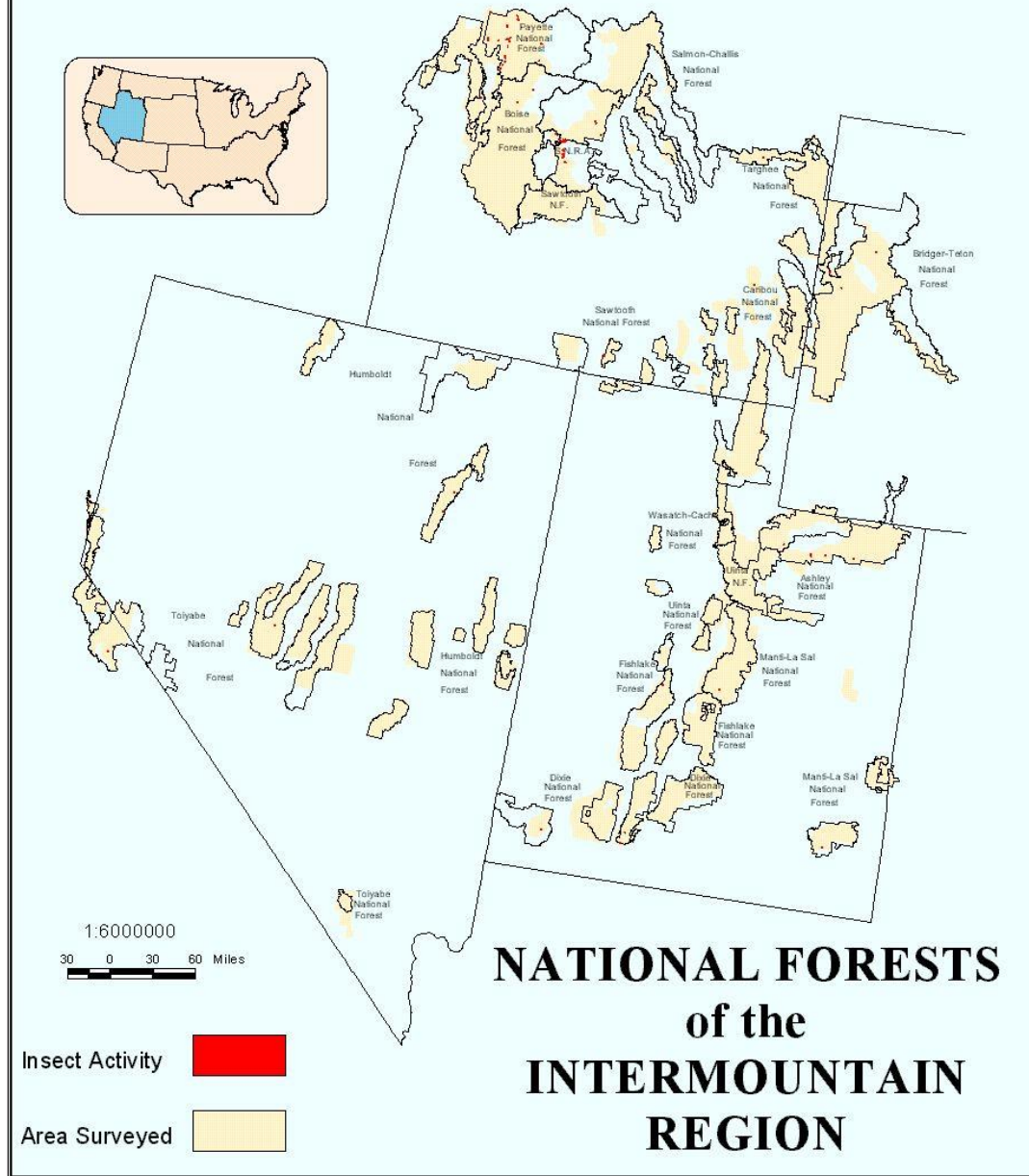


Figure 4. *Tree mortality associated with spruce beetle in Region 4 - 1999 aerial detection survey.*

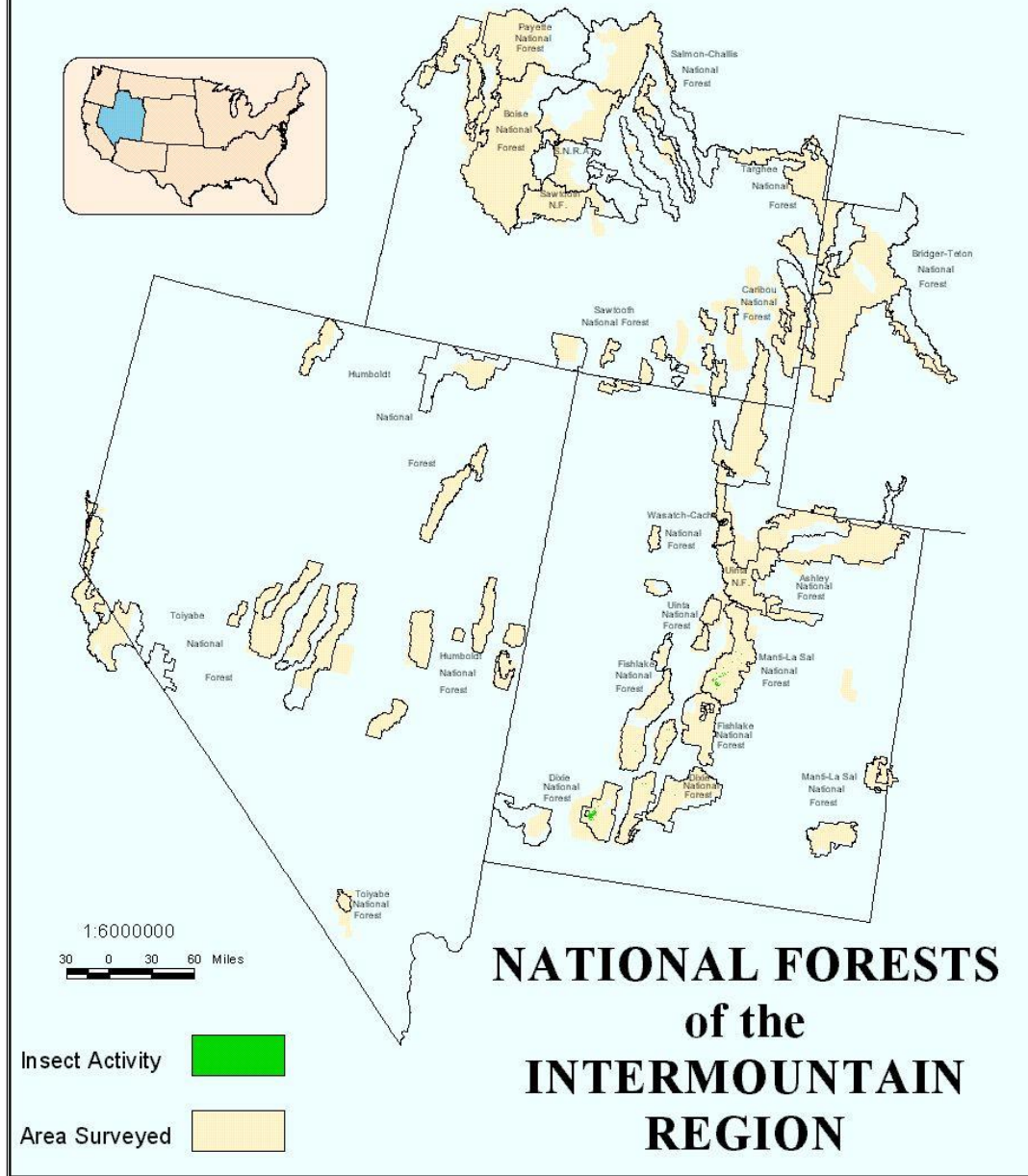


Figure 5. *Tree mortality associated with Douglas-fir beetle in Region 4 - 1999 aerial detection survey.*

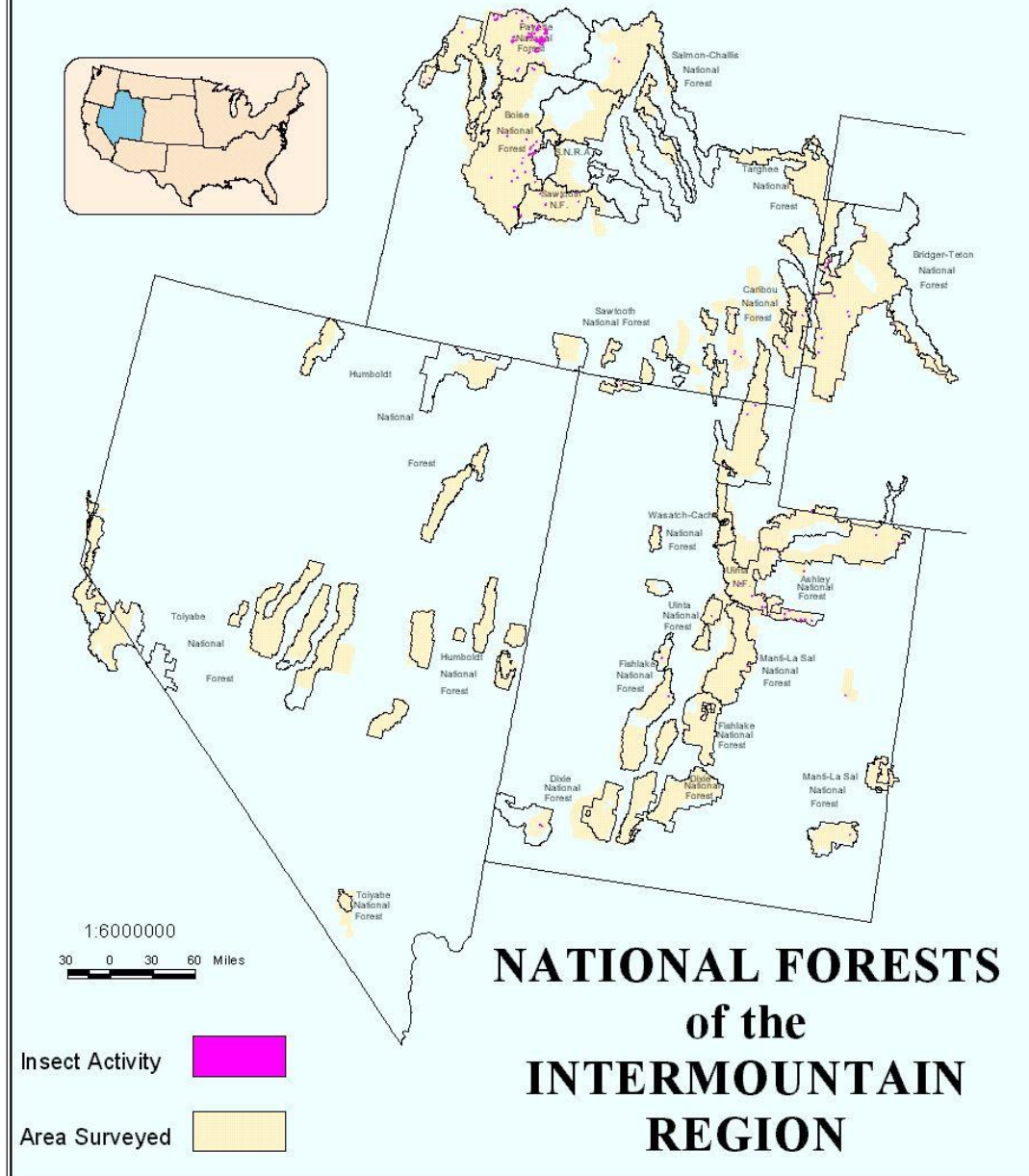


Figure 6. *Tree mortality associated with fir engraver beetle and subalpine fir mortality complex in Region 4 - 1999 aerial detection survey.*

